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## **Off-line Commissioning of EBIS and Plans for Its Integration into ATLAS and CARIBU**

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An Electron Beam Ion Source Charge Breeder (EBIS-CB) has been developed at Argonne to breed radioactive beams from the Californium Rare Isotope Breeder Upgrade (CARIBU) facility at ATLAS. The EBIS-CB will replace the existing ECR charge breeder to increase the intensity and significantly improve the purity of reaccelerated radioactive ion beams. The CARIBU EBIS-CB has been successfully commissioned offline with an external singly-charged cesium ion source. The performance of the EBIS fully meets specifications to breed rare isotope beams delivered from CARIBU. The EBIS can provide charge-to-mass ratios  $\geq 1/7$  for all CARIBU beams with low breeding times in the range from 6 ms to 28 ms. The breeding efficiency into a single charge state of cesium has been demonstrated up to 20%. The overall transmission of cesium beam through the EBIS is 70% routinely and can be increased to 80% with significant effort. A 1.6 Ampere electron beam at a 10 Hz repetition rate and up to a 40% duty cycle has been used for charge breeding experiments. Also, 90% duty cycle at a 30 Hz repetition rate has been demonstrated for a 1.0 Ampere electron beam. Operation at higher repetition rates is required to maintain a high bunching efficiency by avoiding space charge limitation in an RFQ cooler-buncher (CB) which will precede the EBIS-CB. Recently, it was decided to include a multi-reflection time-of-flight (MR-TOF) mass-spectrometer between the RFQ-CB and EBIS-CB. The MR-TOF can provide isobar purification with a mass resolution down to 1/50,000.

The EBIS is ready to be relocated and integrated into ATLAS and CARIBU. A long electrostatic beam transport system including two 180° bends in the horizontal and vertical planes has been designed. Currently, the beam transport system components are being procured and fabricated to be installed and commissioned by the end of this year. This paper will present the results of the EBIS off-line commissioning and discuss the design of the new beamline and the overall integration of the EBIS-CB into ATLAS.